AF/2177

PATENT
Serial No. 09/383,889

#11
5/22/03
A.W.

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellant(s)	Donald F. Caldwell Kenneth Ward Church Glenn Stephen Fowler	
Serial No.	09/383,889 (Conf. No. 7153)	Group Art Unit : 2177
Filing Date	August 26, 1999	
Docket No	113518 A	Examiner: Greta Robinson
Title	DATA COMPRESSION METHOD AND APPARATUS	

COMMISSIONER FOR PATENTS
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APPEAL BRIEF

SIR:

This is an Appeal from a Final Office Action dated April 19, 2002, rejecting each of the pending claims 1-10. The Notice of Appeal was timely filed on July 19, 2002, and received by the Patent Office on July 24, 2002.

The Examiner has indicated that the Appeal Brief timely filed on February 19, 2003 (with an appropriate extension of time pursuant to 37 CFR 1.136(a)), was defective for failure to comply with 37 CFR 1.192(c). Accordingly, applicants respectfully submit the present new Appeal Brief. The period to file this new Appeal Brief expires on May 15, 2003.

1. REAL PARTY IN INTEREST

The real party in interest in the present appeal is AT&T Corp. *See* Assignment, recorded March 6, 2000, at Reel 010708, Frame 0084. AT&T Corp. is the assignee of the entire right, title, and interest in the above-identified application.

2. RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences.

3. STATUS OF CLAIMS

The present patent application was filed on August 26, 1999, and contained claims 1-10. Appellants appeal the final rejection of claims 1-10. A copy of the appealed claims is attached hereto in the APPENDIX.

4. STATUS OF AMENDMENTS

Claims 1-10 stand as originally filed. No amendments have been made or entered.

5. SUMMARY OF INVENTION

The present invention relates to data compression, e.g. such as the GZIP technique utilized pervasively in computer applications. See Specification at page 2. The inventors have observed that conventional compression techniques provide sub-optimal results due to the way the data is presented to the compression application. See Specification at pages 2-3. Applicants recognized that simple metadata could be utilized to transform the data, before compression, in a manner that can optimize known compression techniques such as GZIP. See Specification at pages 3-4, 6-7.

A simple but powerful example is where the data is in tabular form, such as database records. See Specification at page 7. Consider the following database of entries

Name	Rate	Hours
Beth	4.00	0
Dan	3.75	0
Kathy	4.00	10

(This is an excerpt from the example shown in the Specification at page 7). A traditional way of storing such a database is in what is referred to as row major order: in other words, as something like "Beth, 4.00, 0; Dan, 3.75, 0; Kathy, 4.00, 10." See Specification at pages 7-8. Compression of such data, it turns out, is sub-optimal to other ways of arranging this same data. The

inventors have suggested "transforming the data in accordance with a schema", in other words, partitioning and reorganizing the data in a manner that optimizes the compression of the data. See Specification at pages 5-6. Thus, in the above example, the data can be transformed in accordance with a schema that specifies that the data is to be partitioned into portions, i.e., "Beth," "4.00", "0", "Dan", "3.75", "0", etc., and reorganized the portions into three columns of "Beth, Dan, Kathy", "4.00, 3.75, 4.00" and "0, 0, 10". This organization is referred to as column major order. The columns can then be compressed together or separately. See Specification at pages 7-9.

The inventors have determined that partitioning and reorganizing the data in such a fashion can improve the compression results dramatically. See Specification at page 21. For example, the inventors have conducted experiments with massive amounts of telephone call detail records. Simply reorganizing the data into column major order results in an improvement in compression over using GZIP on the same data. See Specification at page 21. FIG. 8 illustrates a more sophisticated schema, where certain selected columns of each telephone call detail record are reorganized and compressed together, as discussed in the Specification at pages 20-21. Where such a schema is utilized, even greater compression results can be obtained, sometimes twice better than merely compressing the untransformed data. See Specification at page 21.

The Specification at pages 9-21 presents numerous alternatives for automating this transformation process of the data, as well as explains why the techniques appear to work from a technical point of view. The inventors believe that the advantages of the schema transformations emanate from the ability to take advantage of dependencies between different portions of the data that are not apparent to conventional compression techniques until the portions are reorganized. See Specification at pages 9-10. The present invention essentially takes advantage of the fact that some data fields have more information than others, and some interactions among fields are important, but most are not. Through the proper analysis of such interactions in the data, the present invention enables improvements in both space and time over conventional compression techniques. See Specification, e.g., at pages 9-10.

6. ISSUES

The issues on appeal are

(i) whether U.S. Patent No. 6,216,213 to Breternitz et al. anticipates each and every limitation of claims 1-5 and 7-10 under 35 U.S.C. 102(e) and

(ii) whether claim 6 is patentable under 35 U.S.C. § 103(a) over U.S. Patent No. 6,216,213 to Breternitz in view of the article Houlding et al., "Low entropy image Pyramids for Efficient Lossless Coding."

7. GROUPING OF CLAIMS

The claims may be grouped as follows:

A. Claims 1, 2, 5, 7, and 8 are directed to a compression method and apparatus wherein the data is transformed in accordance with a schema before compression.

B. Claims 3, 4, 9, and 10 are directed to a compression method and apparatus wherein the data is transformed in accordance with a schema before compression and wherein the transformation step comprises reordering the data into column major order.

C. Claim 6 is directed to a method for generating a schema for improving compression of a stream of data.

A separate basis for patentability exists for each group of claims. Except to the extent otherwise indicated below, the respective groups of claims stand or fall together for purposes of this appeal.

8. ARGUMENT

This appeal turns on a proper reading of U.S. Patent No. 6,216,213 to Breternitz Jr. et al. (hereinafter referred to as the "Breternitz patent"). The Examiner asserts (i) that the Breternitz patent, alone, anticipates each and every limitation of pending claims 1-5 and 7-10, under Section 102(e) and (ii) that, under Section 103(a), the Breternitz patent teaches or suggests most of the limitation of claim 6. Applicants respectfully submit that the Examiner's rejections are based on an incorrect reading of the Breternitz patent and on an improper construction of the pending claims.

I. The Breternitz Patent Does Not Anticipate Each and Every Limitation of Claims 1-5 and 7-10 under Section 102

The Examiner rejected claims 1-5 and 7-10 under 35 U.S.C. § 102(e) solely over the Breternitz patent. A claim is anticipated under Section 102 only "if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987); MPEP 2131. "The identical invention must be shown in as complete detail as is contained" in the claim. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236 (Fed. Cir. 1989). Under no reading of the Breternitz patent can it be said that each and every element of claims 1-5 and claims 7-10 of the present application were so disclosed, as required under Section 102.

Claims 1, 2, 5, 7 and 8 (Group A)

Independent claims 1 and 7 both recite the limitation of "transforming the data in accordance with a schema" wherein the "transformed data" is compressed in a subsequent limitation. As noted in the specification at page 5, lines 19-21, transformation "in accordance with a schema" requires "partitioning and reordering the data in a manner that optimizes the compression of the input data." The Examiner acknowledged this construction of the claim language in the Final Office Action at page 6.

The Breternitz patent does not disclose "transforming the data in accordance with a schema" because it fails to disclose **reordering** or rearranging the data in any manner. Nor does the Breternitz patent disclose partitioning and reordering the data "in a manner that **optimizes** the compression of the input data."

The Breternitz patent, unlike the present invention, is specifically directed the compression of "instruction memory for use in a cache system." Col. 2, lines 41-45. Modern microprocessors, such as the Intel Pentium(c) Processor, utilize advanced caching hardware to feed instructions and data to the CPU. Such caching hardware inherently segments memory into portions referred to as "cache lines" or "cache blocks", as described in the Breternitz patent. As is well known in this field of art, a "cache line" or "cache block" is a unit of memory that can be transferred between the main memory and the cache. See, e.g., "The Free Online Dictionary of Computing," http://burks.brighton.ac.uk/burks/foldoc/17/16.htm.

As discussed in the background section of the Breternitz patent, a recent advance in the use of such cache systems has been compression of the instruction cache in the microprocessor. See Col. 1, Lines 17-67. Microprocessor architectures – before the Breternitz patent – required translation of an address tag into a compressed address location to identify the location of a particular block of compressed memory instructions. See Col. 2, lines 1-13. The Breternitz patent simplifies this address translation process by providing a "one-to-one correlation between the address tag and the compressed memory." See Col. 2, lines 53-67. This obviates the need in the prior art for a look-aside table (LAT) and compressed cache look-aside buffers (CLB) to decode sequentially addressed cache tags. It is this advantage over the prior art – simplifying the address translation process – that motivates the Breternitz patent and distinguishes it from the prior art. The Breternitz patent is not specifically directed to improving the compression process itself and provides no guidance as to how to improve compression results. Rather, the Breternitz patent is directed to the narrow issue of how to address a compressed processor instruction in a compressed instruction cache.

The Examiner relies on three mutually-contradictory theories on how the Breternitz patent discloses the recited limitation of "transforming the data in accordance with a schema":

(1) First, the Examiner contends that the following passage from the Breternitz patent fully discloses the claimed limitation:

> After compression and upon subsequent decompression, this **transformed address** is to be quickly and unambiguously divisible into the starting address of the compressed cache line in compressed memory and the word offset identifying the instruction location within the cache line.

Col. 3, lines 24-29 (emphasis added). As pointed out in appellant's response to the Examiner's first office action, this assertion, at a minimum, appears to reflect some confusion regarding what is being "transformed" in the above passage. What is being "compressed" in the Breternitz patent are **processor instructions** in the cache line. What is being "transformed" in the passage above are specifically **addresses** for locating the processor instructions in the cache memory. Accordingly, the data to be compressed, namely the processor instructions in the cache line, are not "transformed" in the above passage – let alone "transformed in accordance with a schema."

(2) Next, the Examiner argues in the Final Office Action that the claimed limitation of "transforming the data in accordance with a schema" is fully disclosed in what is merely referred to as "pre-compression activity" in FIG. 1 and FIG. 4 of the Breternitz patent. This interpretation reads far too much into these three words. The text in the Breternitz patent corresponding to the step referred to as "pre-compression activity" in FIG. 1 is enlightening. It merely states that "pre-compression steps" as mentioned in FIG. 1 "will include such steps as compiling and linking of source code." Col. 3, Lines 5-7. Thus, the "pre-compression activity" referred to in the figures of the Breternitz patent merely refers to the conventional activities of preparing a computer program for execution on a CPU with a cache memory—and, thus, this is not any kind of activity that could be characterized as a schema transformation.

(3) Finally, the Examiner argues that the claimed limitation is fully disclosed in the abstract of the Breternitz patent, which refers to "memory" being "divided into cache line blocks". The notion of cache memory and how memory is inherently segmented into addressable portions referred to in the art as "cache line blocks" is discussed above. The Examiner, in essence, asserts that the mere fact that memory is segmented into cache blocks fully discloses the notion of a schema transformation, as recited in the pending claims.

There are multiple difficulties with this interpretation of the Breternitz patent. As mentioned above and acknowledged by the Examiner, the recited limitation of "transforming the data in accordance with a schema" does **not** cover any so-called "transformation" of any data. As set forth in the specification, transformation "in accordance with a schema" requires "partitioning and reordering the data in a manner that optimizes the compression of the input data." Page 5, Lines 19-21. Segmenting the memory into cache blocks does not disclose or suggest partitioning and **reordering** the data in a manner that **optimizes the compression** of the input data. In fact, the "data" to be compressed in the Breternitz patent, namely the program instructions in the instruction cache, **cannot** be reordered without, in essence, changing the

nature of the program itself. The CPU expects the program instructions in a particular order, regardless of whether the instructions are compressed or not. The compression in blocks of memory cache lines is an aspect of hardware memory allocation that enables the use of the addressing scheme set forth in the Breternitz patent (which enables compressed program instructions to be referenced by addresses in the compressed cache blocks). The division into cache blocks in the Breternitz patent does **not** have anything to do with reorganizing the divided portions in a manner to optimize compression. The Breternitz patent simply does not disclose reordering the data in any manner and is unconcerned with optimization of the compression process itself.

Thus, the Breternitz patent at a minimum fails to disclose the limitation of "transforming the data in accordance with a schema" and, accordingly, cannot anticipate claims 1 and 7 under Section 102(e). Independent claim 5 similarly recites the limitation of "transforming the data in accordance with a schema" after decompressing a compressed version of the transformed data. Claims 2 and 8 are dependent upon claims 1 and 7, respectively, and accordingly incorporate all of the limitations of claims 1 and 7.

Applicants respectfully submit that claims 1, 2, 5, 7 and 8 represent allowable subject matter.

Claims 3, 4, 9 and 10 (Group B)

Claims 3, 4, 9 and 10 are also dependent upon claims 1 and 7, and, accordingly, incorporate all of the limitations of claims 1 and 7. Thus, all of the arguments discussed above with respect to claims 1 and 7 are equally applicable to claims 3, 4, 9 and 10.

Furthermore, claims 3, 4, 9 and 10 also include the limitation of "reordering the data into column major order" as a part of the schema transformation. The significance of reordering data in column major order is explained above in the summary of invention. Reordering a database that is stored in row major order into column major order before compression can significantly improve compression results for many types of databases.

The Examiner's Section 102(e) rejection of these claims rests on the assertion that element 140 in FIG. 1 of the Breternitz patent discloses this limitation in its entirety. Element 140 so reads in its entirety: "COMPACT EACH COMPRESSED CACHE-LINE BLOCK INTO MEMORY." As mentioned above, the "cache line" is well-known term in microprocessor architectures which refers to a data channel between main memory and a hardware cache. The

cache line is separated into cache line "blocks" which are addressed using the scheme disclosed in the Breternitz patent. As discussed above, the mere fact that blocks of the cache line are compressed does not in any way disclose the schema transformation referred to in the claims. Moreover, claims 3, 4, 9 and 10 additionally require that the data that is the subject of the schema transformation be reordered into column major order. The Breternitz patent does not reorder the cache line blocks in any manner. Indeed, it cannot, as this will change the order of the program instructions in the cache line, thereby destroying the integrity of the program. Thus, there is no disclosure in the Breternitz patent of rearranging the data in a cache line – let alone "reordering the data into column major order."

Applicants respectfully submit that claims 3, 4, 9, and 10 represent allowable subject matter.

II. Claim 6 (Group C) Is Patentable Over the Breternitz Patent and the Coding Article under Section 103

Claim 6 is an independent claim directed to a specific technique for generating a schema that could be used to improve compression of a stream of data. Claim 6 recites the following limitations:

(i) "separating a sample of the data into a first portion of low entropy and a second portion of high entropy";

(ii) "partitioning the second portion into columns"; and

(iii) "searching for combinations of columns that minimize the compressed size of the sample."

The Examiner rejected claim 6 under 35 U.S.C. § 103(a) over the Breternitz patent in view of an article entitled "Low Entropy Image Pyramids for Efficient Lossless Coding" by David Houlding and Jacques Valsey. The Examiner's rejection asserts that the Breternitz patent basically discloses everything in the claim except "separating a sample of data through entropy". Final Office Action, at page 5. Applicants respectfully disagree.

Claim 6 requires that a sample of data be separated into two portions, that a portion of high entropy by partitioned into columns, and that different combinations of columns be searched for a combination that minimizes the compressed size of the sample. The Examiner's rejection of claim 6 provides no citation to the Breternitz patent, merely stating that "Breternitz Jr. et al. teaches 'generating a schema for improving compression of a stream of data' through compression of data and partitioning portions of the data through cache line blocks (500)...."

Even if the cache line blocks could somehow be characterized as "columns"—which in and of itself makes no sense since the cache lines are lists of program instructions and have no notions of "rows" and "columns"—there is at a minimum no teaching or suggesting of "searching for combinations of columns that minimize the compressed size of the sample." The cache line blocks in the Breternitz patent cannot be reorganized in a search for different combinations that minimize a compressed size. The cache line in the Breternitz patent contains compressed program instructions and cannot be reordered into different combinations—not without changing the order of the program instructions in the cache line.

The Houlding reference is cited in the Examiner's rejection as disclosing "the effects of low entropy and high entropy." Final Office Action, at pages 5-6. The Houlding reference is specifically directed to image source coding techniques, in other words to the issues of encoding an image into a digital representation. The Houlding reference refers to generating a pyramid structure in which subimages are entropy encoded. The "subimages" referred to in the Houlding reference are the complicated results of filtering the original image in a particular manner described in the reference. Part of the coding design in the Houlding reference is to minimize the entropy of this pyramid structure in order to obtain a lower entropy representation of the image.

The Houlding reference, however, makes no reference to partitioning a sample of a data set into a first portion of low entropy and a second portion of high entropy. Furthermore, the Houlding reference makes no reference to processing high entropy data in a manner to improve compression results, i.e. by partitioning the high entropy data into columns that are combined in different ways. The Houlding reference, at best, is silent as to improving compression through the proper processing of high entropy data in a data stream.

More importantly, there is no motivation to combine the Houlding reference with the Breternitz patent in any meaningful way. The Breternitz patent, as discussed above, deals with an addressing scheme for compressed cache memory in microprocessor architectures. It does not deal with improving compression results or improving image coding. The Houlding reference specifically deals with improving the performing of image source coding techniques. Not only is it doubtful one of ordinary skill in the art would be skilled in both fields, combining the two references results in an incoherent hodgepodge—and not anything that resembles the claimed invention.

Accordingly, applicants respectfully submit that claim 6 represents allowable subject matter.

CONCLUSION

In summary, the Breternitz patent does not anticipate claims 1-5 and 7-10 under Section 102(e), and claim 6 is patentable over the Breternitz patent in view of the Houlding reference under Section 103. The Breternitz patent simply does not disclose a schema transformation and optimizing compression by reorganizing the data to be compressed. A reversal of the Examiner's Final Rejection is respectfully solicited.

The Office is hereby authorized to charge any additional fees or credit any overpayments under 37 C. F. R. 1.16 and 1.17 to **AT&T Corp. Deposit Account No. 01-2745 .**

Respectfully submitted,
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Date: May 14, 2003

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APPENDIX

(BRIEF of Appellants Caldwell et al., U.S. Patent Application, Serial No. 09/383,889)

CLAIMS ON APPEAL

1. A method for improving compression of a stream of data comprising:
transforming the data in accordance with a schema; and
compressing the transformed data.

2. The method of claim 1 wherein the transformation step further comprises the step of partitioning the data into a first and second portion which are separately compressed.

3. The method of claim 1 wherein the transformation step further comprises the step of reordering the data into column major order.

4. The method of claim 3 wherein the transformation step further comprises the step of partitioning the data into columns which are separately compressed.

5. A method for retrieving a stream of data from a stream of compressed data which has been compressed in accordance with claim 1, the method comprising:
decompressing the compressed data; and
transforming the data in accordance with a schema.

6. A method for generating a schema for improving compression of a stream of data comprising:
separating a sample of the data into a first portion of low entropy and a second portion of high entropy;
partitioning the second portion into columns;
searching for combinations of columns that minimize the compressed size of the sample.

7. An apparatus for improved compression of a stream of data comprising:
means for transforming the data in accordance with a schema; and
means for compressing the transformed data.

8. The apparatus of claim 7 wherein the transforming means further comprises means for partitioning the data into a first and second portion which are separately compressed.

9. The apparatus of claim 7 wherein the transforming means further comprises means for reordering the data into column major order.

10. The apparatus of claim 9 wherein the transforming means further comprises means for partitioning the data into columns which are separately compressed.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in this Submission	

Application Number	09/383889
Filing Date	08/26/1999
First Named Inventor	Donald F Caldwell et al.
Group Art Unit	2177
Examiner Name	G. Robinson
Attorney Docket Number	113518A

Enclosures *(check all that apply)*

- ☒ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment / Response
  - ☐ After Final
  - ☐ Affidavits / Declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Response to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Response to Missing Parts/Incomplete Application
- ☐ Assignment & Recordation Cover Sheet
- ☐ Drawing(s) & Letter to Official Draftsman
- ☐ Licensing-related Papers
- ☐ Petition to the Commissioner
- ☐ Petition to Convert a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ After Allowance Communication to Group
- ☐ Appeal Communications to Board of Appeals and Interferences
- ☒ Appeal Communications to Group *(Appeal Notice, Brief, Reply Brief)*
- ☐ Proprietary Information
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Remarks

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Type or Printed Name	Rosemary Dworetsky		
Signature		Date	5/14/2003

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FEE TRANSMITTAL

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TOTAL AMOUNT OF PAYMENT	$320

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Application Number	09/383889
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First Named Inventor	Donald F Caldwell et al.
Examiner Name	G. Robinson
Group/Art Unit	2177
Attorney Docket No.	113518A

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METHOD OF PAYMENT (check one)

1. The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

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☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing Date of the Notice of Allowance

FEE CALCULATION

1. FILING FEE

Large Fee Code	Entity Fee($)	Fee Description	Fee Paid
1001	750	Utility(37CFR 1.53(b)) / CPA(37CFR 1.53(d)) Filing Fee	
1002	330	Design Filing Fee	
1004	750	Reissue Filing Fee	
1005	160	Provisional Filing Fee	

SUBTOTAL (1) 0

2. CLAIMS

☐ Filing Under 37CFR 1.53 (b)

☐ CPA Under 37CFR 1.53 (d)

☐ Amendment

		Extra Claims		Fee from below		Fee Paid
Total	- 20=	0	x	18	=	0
Ind.	- 3=	0	x	84	=	0
Multiple Dependent Claims					=	0

Large Fee Code	Entity Fee($)	Fee Description
1202	18	Claims in excess of 20
1201	84	Independent Claims in excess of 3
1203	280	Multiple Dependent Claims
1204	84	** Reissue independent claims over original patent
1205	18	** Reissue claims in excess of 20 and over original patent

** or number previously paid, if greater; for Reissues, see above

SUBTOTAL (2) 0

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Fee Code	Entity Fee($)	Fee Description	Fee Paid
1051	130	Surcharge - late filing fee or oath	
1052	50	Surcharge - late provisional filing fee or cover sheet	
1053	130	Non-English specification	
1812	2520	For filing a request for reexamination	
1804*	920	Requesting publication of SIR prior to Examiner action	
1805*	1840	Requesting publication of SIR after Examiner action	
1251	110	Extension for response within first month	
1252	410	Extension for response within second month	
1253	930	Extension for response within third month	
1254	1450	Extension for response within fourth month	
1255	1970	Extension for response within fifth month	
1401	320	Notice of Appeal	
1402	320	Filing a brief in support of an appeal	320
1403	280	Request for oral hearing	
1504	300	Publication fee for early, voluntary, or normal publication	
1452	110	Petition to revive – unavoidable	
1453	1300	Petition to revive – unintentional	
1501	1300	Utility issue fee (or reissue)	
1502	470	Design issue fee	
1460	130	Petitions to the Commissioner	
1807	50	Processing fee for provisional applications	
1806	180	Submission of Information Disclosure Statement	
8021	40	Recording each patent assignment per property (times number of properties)	
1809	750	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	750	For each additional invention to be examined (37 CFR 1.129(b))	
1801	750	Request for Continued Examination (RCE)	
1802	900	Request for expedited exam of a design application	
Other fee (specify):			

SUBTOTAL(3) 320

SUBMITTED BY

Typed or Printed Name	Cedric G. DeLaCruz			Reg. Number	36498
Signature		Date	5-14-03	Deposit Account User ID	

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